


Charting our Courses: Use of Knowledge Surveys

Presentation to the OPI Assessment Conference
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Montana Tech of the University of Montana
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My history

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- ▶ 1990 BS Chemistry w/Bioscience option, University of Pittsburgh
 - ▶ 1990-1992 Paint Chemist, PPG Industries
 - ▶ 1992-1998 PhD Program, University of Pittsburgh Biology Department
 - ▶ 1998-2000 Postdoc, WSU Biochemistry&Biophysics
 - ▶ 2000-2005 University of Pittsburgh Pittsburgh Bacteriophage Institute Genome Center and Outreach
 - ▶ 2005-present Montana Tech, NIH-INBRE hire

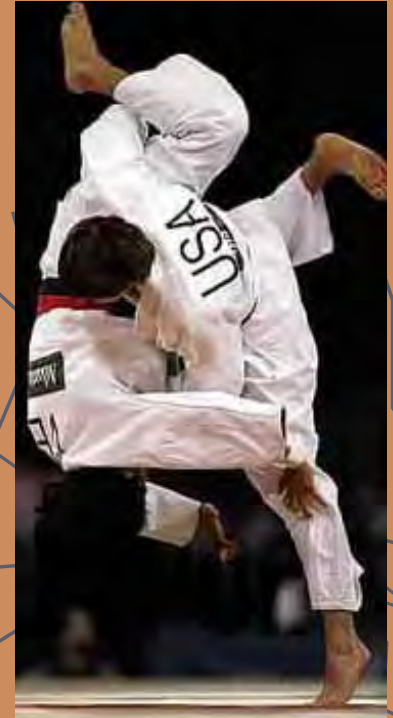
Personal

Married Dean Markovics, 1992

1996 US Olympic Judo Team

Leanna and Kyle, 2000 and 2002

Prague and Franklin, 2008



Talk Overview

One attempt to answer the recurring question:
“What (the heck) do my students know and is my course helping?”

A report of the use of knowledge surveys at Montana Tech for general and course-specific knowledge in Biological Sciences



Talk Overview

- “Need” for Assessment
- Knowledge Surveys Background
- Transferability (General Knowledge)
- Course-specific questions
- Benefits for instructor
- Benefits for students
- **Results**
 - Areas for Improvement
 - **DISCUSSION** (throughout)

Assessing our Students and Our Courses: Why?

- Departmental Standards
- Help for Adjunct Faculty
- Portfolios for Promotion
- Merit Pay??

Course-specific questions

- Don't want to duplicate too much course-to-course, so I want to know what concepts they already know
- Yet, I want to be SURE they know certain basics
- Outcomes: Want to know if the course helps them learn, what it helped them learn, and to quantify this!!

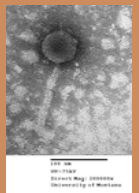
Transferability

If there are MUS guidelines for what a course should cover?

In Biology, there were such discussions for Intro Bio courses...49 separate “core understandings”

We wondered how much of this info students are getting in their intro courses and in their entire career at Tech, course by course

Knowledge surveys seemed like a possible means to achieve this goal



What are Knowledge Surveys?

Ed Nuhfer, ISU presented this to I.I.C.

Students don't answer the question but judge whether they can answer the question

Only 3 Answers: A, B, or C

Quick: can cover VAST amounts of material

Give instructor the idea of what students know before the semester

Give students an idea of what will be covered in the semester

Given before and after the course

Indicate gains in student knowledge (or at least their confidence in their knowledge)

Reportedly they accurately reflect student knowledge



Instructions

This is a knowledge survey rather than a test. The purpose of this survey is to serve as a study guide and to help you and the instructor evaluate the change produced in your knowledge by this course. In this knowledge survey, you won't actually try to answer any of the questions provided. Instead, you will rate (on a three-point scale) your confidence to answer the items based on your present knowledge. Read each question and then respond by writing an A, B or C below the question in accord with the following rating.



Instructions

Mark an "A" as response ONLY if you feel confident that you can now answer the question sufficiently for graded test purposes. Mark a "B" response to the question if you can now answer at least 50% of it or if you know precisely where you could quickly get the information needed and could return here in 20 minutes or less to provide a complete answer for graded test purposes. Mark a "C" as response to the question if you are not confident that you could adequately answer the question for graded test purposes at this time. These marking of an "A" "B" or "C" will go quickly after you get the hang of responding based on confidence.



Instructions

Accurate self-assessment is a practical skill that is more important than even current content knowledge. It is important to make an accurate self-assessment so that you can obtain the best learning enhancement from a knowledge survey. What constitutes a successful response to this survey is an accurate self-assessment, one that neither overestimates nor underestimates the knowledge that you now currently have. Do your best to provide a very honest assessment of your present knowledge. If you mark an "A" or a "B" that states you have significant background to answer a question, you should be confident that if your professor asks you to demonstrate that ability by actually answering the so-designated questions, that you could actually respond for graded test purposes.

This survey will be given again at the end of the semester. I will give you a copy of the survey; refer to the items as we progress through the course in order to monitor your increasing mastery of the material as we proceed through the semester.



Benefits for Instructors

Efficiency and Transparency:

Don't waste time on stuff they already really know well

Don't miss covering stuff they don't know that maybe we assumed they knew

Students know what they need to learn, chapter by chapter...it guides them in their reading and studying

Lectures can incorporate these questions

Quiz and tests can easily be based on these questions

Benefits for Students

Efficiency

They get an up-front view of the course

They get a really quick look at what they already know and don't know

They know what the instructor feels is critical

They know what they need to learn, chapter by chapter

Biology Core Knowledge

49 Questions from Transferability Meetings

Should be learned in intro biology (2 semesters), but surely by graduation!

Covering Cell, Ecology, Evolution

Idea is these could be given to EVERY biology course, before and after

Biology Core Knowledge

1	How is biology relevant to everyday life?
2	How do biologists 'do' science?
3	What are the defining characteristics of life?
4	What are atoms, elements, molecules, and how are they bonded together?
5	What are the characteristics of water and how are they important to life?
6	What are the major groups of biomolecules and what are their functions?
7	What is the modern concept of the cell theory?
8	What are the two major types of cells and how do they differ from each other?
9	What is the composition, structure and function of cell components?
10	What is energy and what are the laws of thermodynamics as they relate to biology
11	What is ATP and how is it important?
12	What are enzymes and how do they function?
13	What is the basic process and significance of cellular respiration?
14	What is the basic process and significance of photosynthesis?
15	What are chromosomes?
16	How do procaryotic cells reproduce?
17	What is the cell cycle and why is it controlled?
18	How do eucaryotic cells reproduce?
19	What are the basic processes of mitosis and meiosis and what is their significance?
20	What mistakes can occur during cell reproduction?
21	What are the basic principles of Mendelian genetics?
22	What are genes, and how do genes and alleles interact?
23	What is DNA and what is the chromosomal basis of inheritance?
24	What is the Central Dogma and how does information flow in a cell?
25	What are the mechanisms and causes of human genetic diseases?



Biology Core Knowledge

26	What is biotechnology, and how does genetic engineering work?
27	What is evolution?
28	What is microevolution and what is macroevolution?
29	What is the diversity of evidence that supports evolution?
30	How does evolution occur?
31	What is adaptation and natural selection and how do they work?
32	What are species and how do new species arise?
33	What were the conditions of prebiotic earth?
34	What are the key components of chemical evolution?
35	How did living organisms alter their environment and affect the evolution of other life forms?
36	What is the chronology of the development of diversity?
37	How did humans evolve and what characteristics differentiate humans from non-human primates?
38	How do we classify the diversity of living organisms?
39	What are bacteria, protists, fungi, plants and animals?
40	What are viruses, and are they alive?
41	What is ecology and what is environment?
42	What are biomes?
43	How do populations grow and what are the limiting features of population growth?
44	How has the human population grown and how can human population growth be controlled?
45	How do populations of organisms interact?
46	How do communities change over time?
47	How do organisms participate in the cycling of nutrients?
48	How is energy and nutrients transferred among living organisms?
49	How have humans had an effect on the biosphere?

Molecular Biology Lab

34 questions

Knowledge and techniques

Genetics Lab

32 questions

Knowledge and techniques

Molecular Biology Lab Knowledge

#	Question
1	I know what PCR is
2	I know what is included in a PCR Reaction
3	I know what a restriction endonuclease is
4	I know how to design primers for PCR
5	I know what a microliter is
6	I know how to choose the correct micropipettor to measure 20 microliters
7	I am confident that I can accurately micropipette
8	I know the order to add things to a restriction digestion
9	I know generally what electrophoresis is and what it is used for
10	I know exactly how to prepare an agarose gel
11	I know how to set up and run an agarose gel electrophoresis
12	I know how to photograph an agarose gel after it is run
13	I know what ethidium bromide is used for
14	I know what SDS-PAGE stands for
15	I know how to set up an SDS-PAGE gel
16	I know how to load and run an SDS-PAGE gel
17	I know what Coomassie blue is used for



Molecular Biology Lab

18	I know what a kD is
19	I know what a bp is
20	I know what transformation is
21	I know what antibiotic selection is
22	I know what a plasmid is
23	I know what cloning is
24	I know what recombinant protein expression is
25	I know what a bacteriophage is
26	I know what a mycobacteriophage is
27	I know how to amplify a specific gene from a mycobacteriophage
28	I know how to add restriction sites and amplify a specific gene from a mycobacteriophage
29	I know what Maltose Binding protein is
30	I know what affinity chromatography is
31	I know what a protein is
32	I know what a gene is
33	I know what the genetic code is and how a DNA sequence determines a protein sequence
34	I know how a cell uses a gene sequence to generate a protein



Molecular Biology Knowledge

**331 Questions, 282 from chapters
plus 49 General Knowledge
Questions**

Broken down chapter by chapter

Genetics Specific Knowledge

**563 Questions, 514 from chapters
plus 49 General Knowledge
Questions**

Broken down chapter by chapter

Molecular Biology Knowledge

Chapter by Chapter

DNA Recombination and Repair

- What are the types of mutations and their phenotypic consequences?
- What are trinucleotide repeats and their consequences?
- What are the general classes of DNA damage?
- What are the cellular responses to DNA damage?
- What occurs in base excision, mismatch and nucleotide excision repair?
- What are the types and results of double strand break repair?



How long did it take?

Writing the questions

Just a few hours with text the day before the semester....also gave me more insight in the text, how it is laid out, material covered

Giving the survey

About thirty minutes each during the first and last classes of the semester for the molecular survey (331 questions) and less than 10 minutes for the molecular lab survey (34 questions)

Tabulating the results

For the big survey, I entered them chapter by chapter the day prior to covering that chapter. This took only a few minutes each and let me know “fresh” what they knew about that topic before their reading or my lecture.

Analyzing the results



How much time did it save?

Preparing lectures and writing quizzes and exams was vastly expedited.

- I put the questions directly into power points, and asked the students try to answer them before advancing the slide to the relevant figures or text to answer it.
- The questions or modifications thereof became quiz and essay questions.

Scoring the Data

$$A=5$$

$$B=3$$

$$C=0$$

$$\text{Score} = (5X\#A's + 3X\#B's) / (\#A + \#B + \#C)$$

Ranges from 0 to 5

Chapter by Chapter

	Chapter 7: DNA Repair and Recombination	A	B	C	Score
168	What are the types of mutations and their phenotypic consequences?	0	8	1	2.67
169	What are trinucleotide repeats and their consequences?	0	4	5	1.33
171	What are the cellular responses to DNA damage?	0	3	6	1.00
170	What are the general classes of DNA damage?	0	2	7	0.67
173	What are the types and results of double strand break repair?	0	2	7	0.67
172	What occurs in base excision, mismatch and nucleotide excision repair?	0	1	8	0.33

Before covering each chapter in lecture, I could see how comfortable the students were with certain topics within.

These questions became their study guides as they read the chapter. I split the questions out and posted to Blackboard.



Fall 2008 Results

Fall 2008 Results Before the semester

General Knowledge

9 students, 49 questions,
133 A's, 220 B's, 87 C's
Average score 3.01

Molecular Lab

10 students, 34 questions
122 A's, 137 B's, 81 C's
Average score 3.00

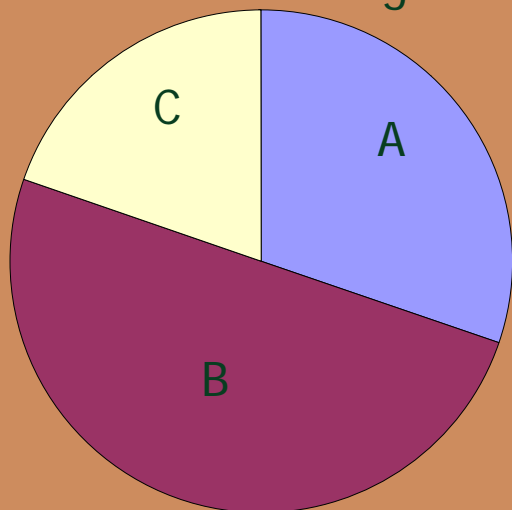
Molecular Biology

9 students 331 questions,
406 A's, 1130 B's, 1442 C's
Average score 1.81



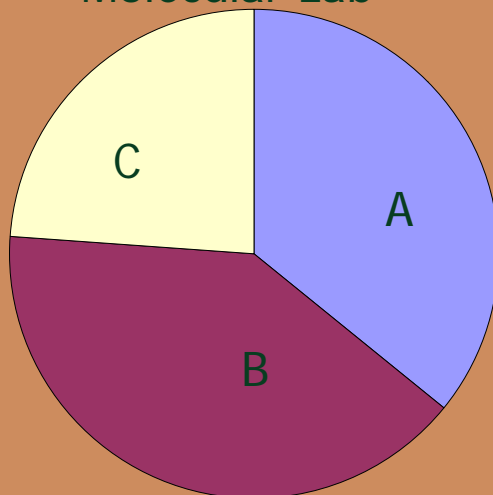
Fall 2008 Results Before the semester

General Knowledge



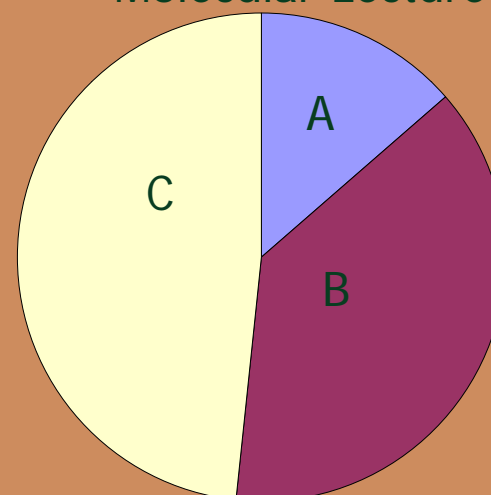
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Molecular Lab



10 students,
34 questions
122 A's, 137 B's, 81 C's
Average score 3.00

Molecular Lecture



9 students
331 questions,
406 A's, 1130 B's, 1442 C's
Average score 1.81

Fall 2008 Results After the semester

Before Semester

General Knowledge

9 students, 49 questions,
133 A's, 220 B's, 87 C's
Average score 3.01

Molecular Lab

10 students, 34 questions
122 A's, 137 B's, 81 C's
Average score 3.00

Molecular Biology

9 students 331 questions,
406 A's, 1130 B's, 1442 C's
Average score 1.81



After Semester

General Knowledge

8 students, 49 questions,
273 A's, 119 B's, 0 C's
Average score 4.39

Molecular Lab

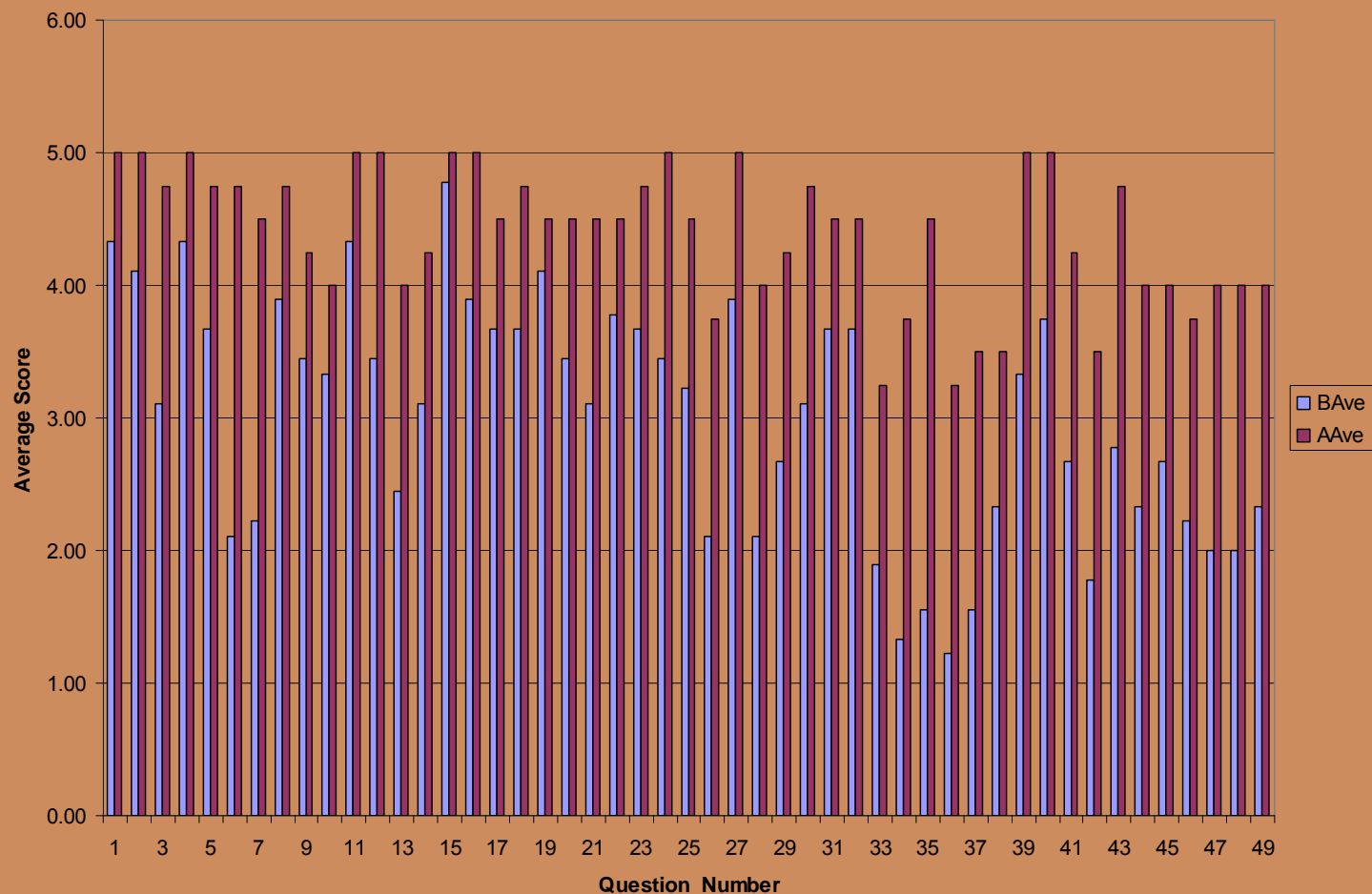
10 students, 34 questions
273 A's, 64 B's, 3 C's
Average score 4.48

Molecular Biology

8 students 331 questions,
1777 A's, 855 B's, 24 C's
Average score 4.72

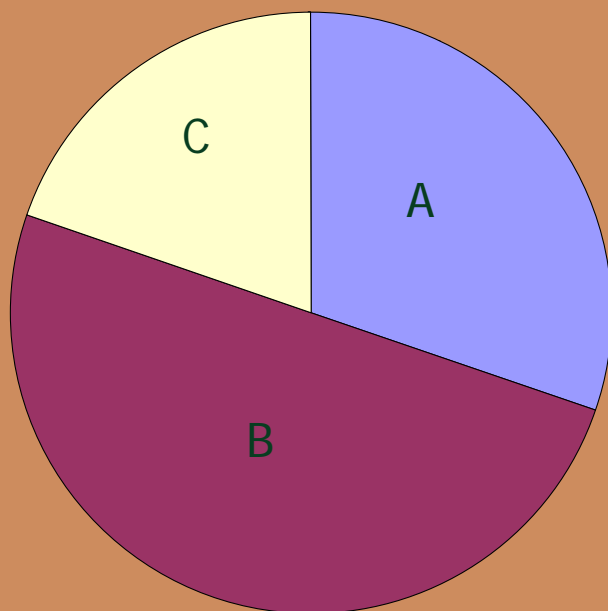
Core Knowledge Results

General Biology Knowledge

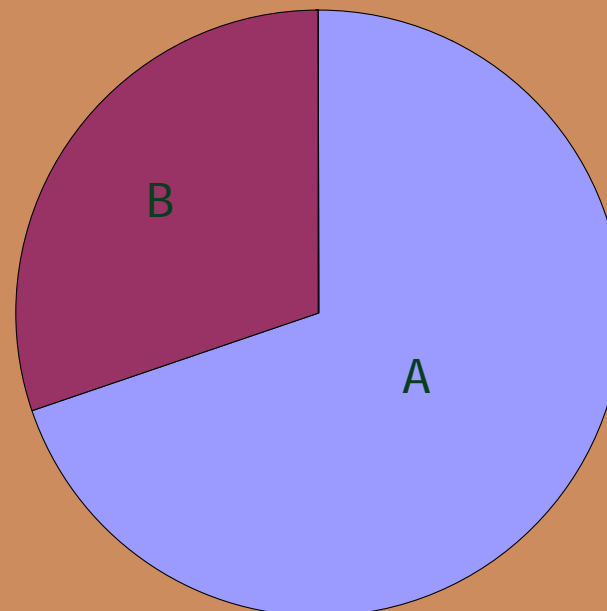


2008 Core Knowledge Results

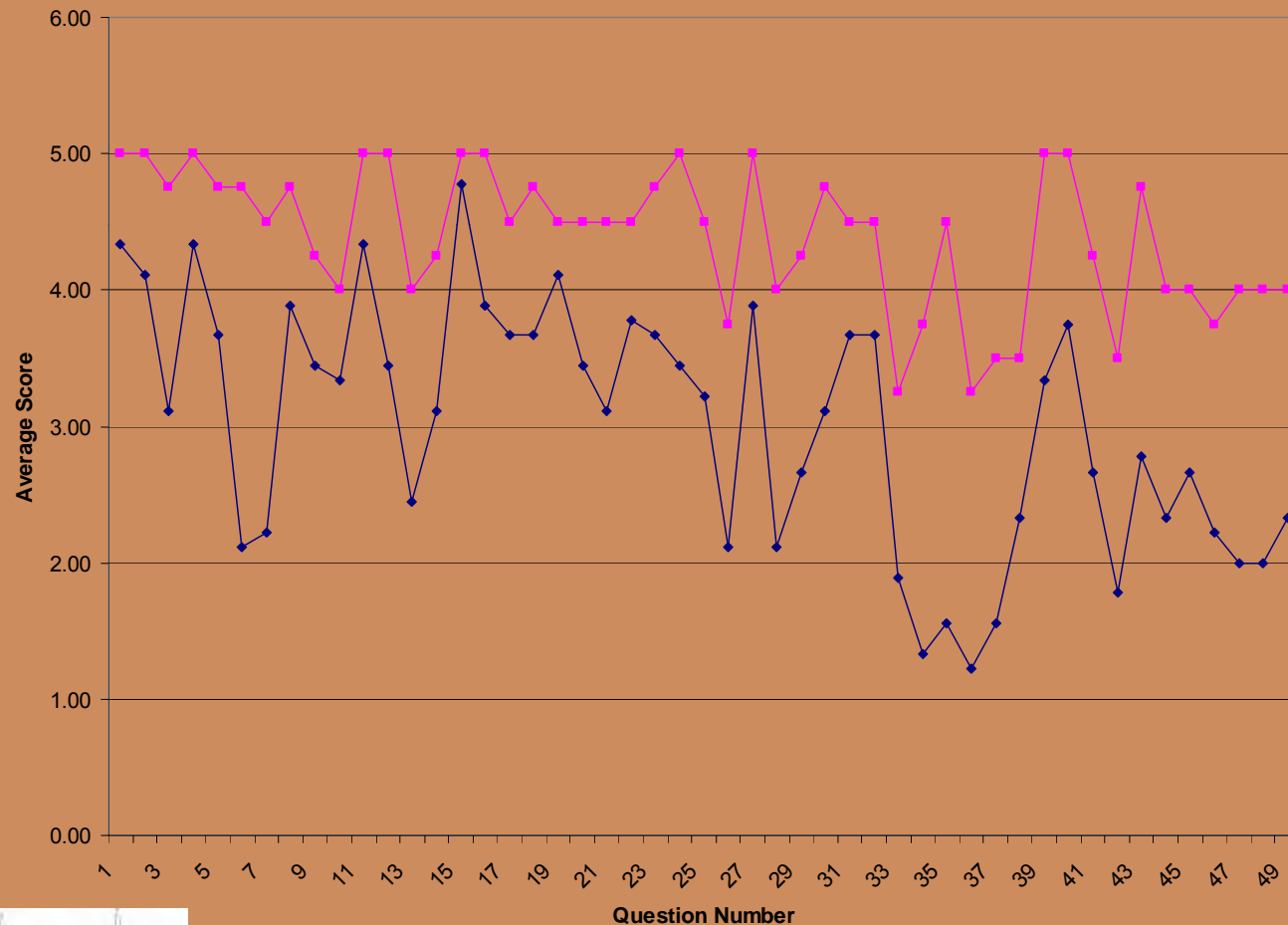
Before Semester
3.01



After Semester
4.39



2008 Core Knowledge Results



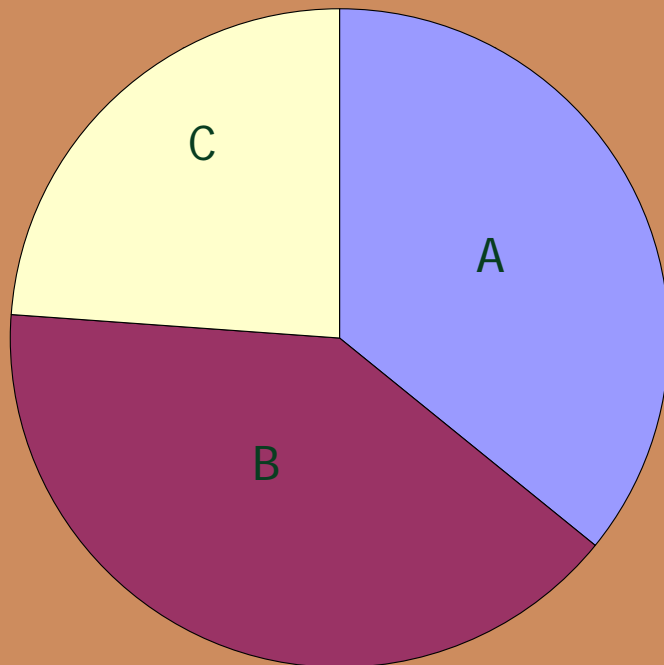
**After Semester
4.39**

**Before Semester
3.01**

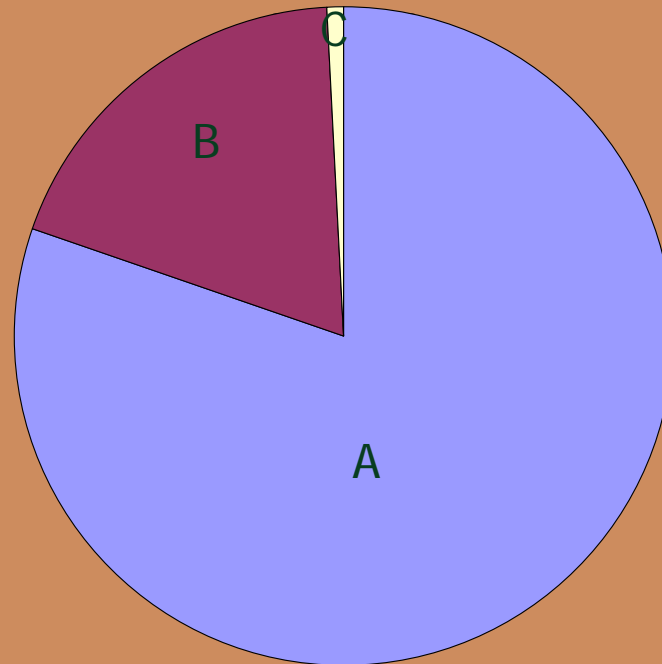


Molecular Biology Lab Results

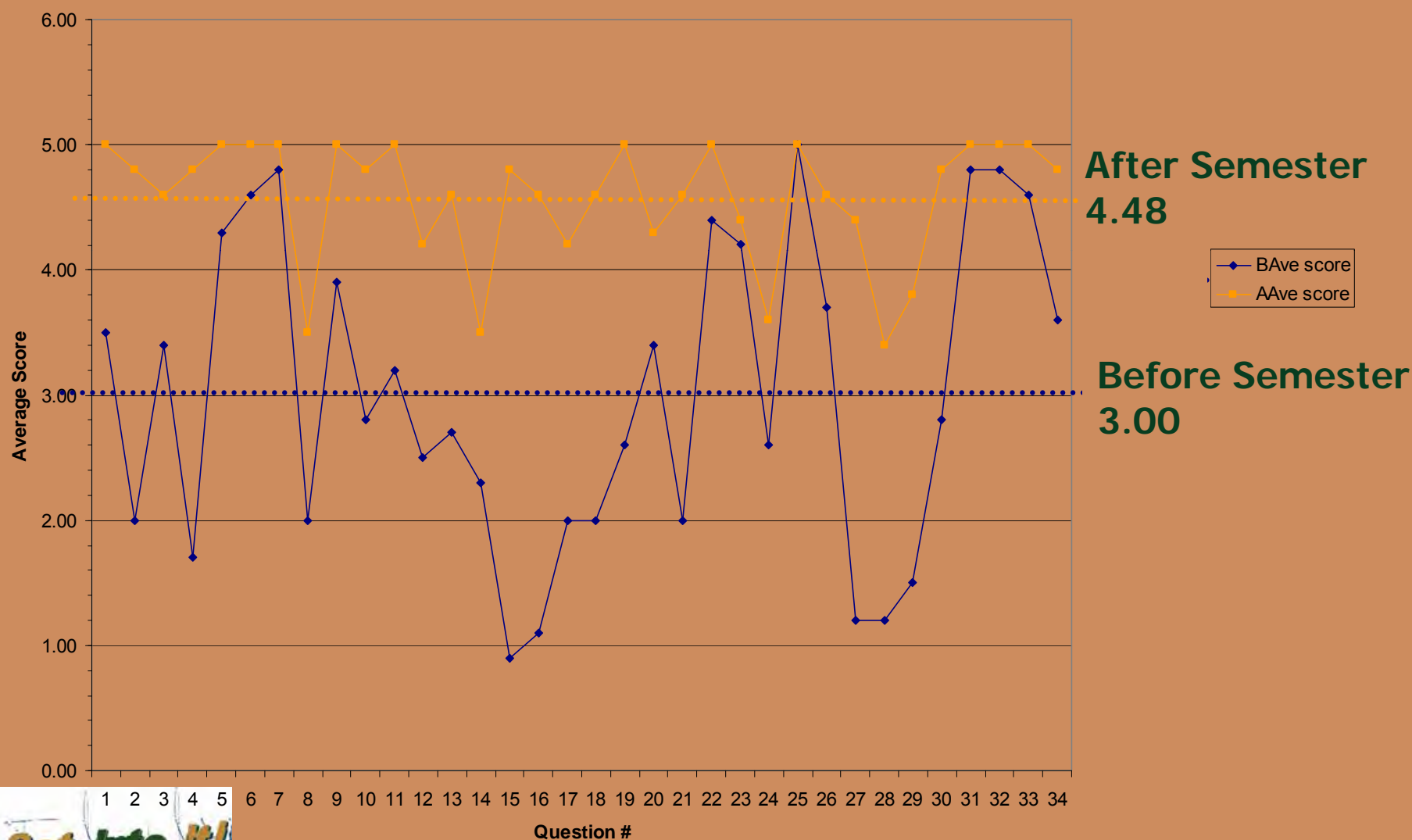
Before Semester
3.00



After Semester
4.48

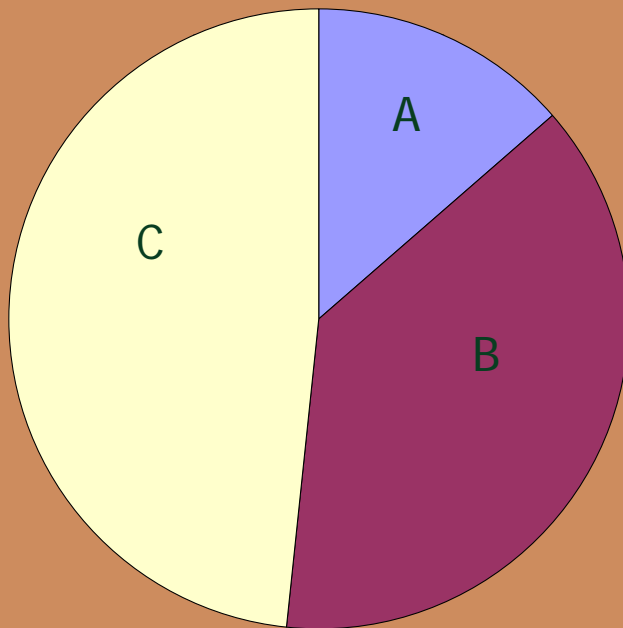


Molecular Biology Lab Results

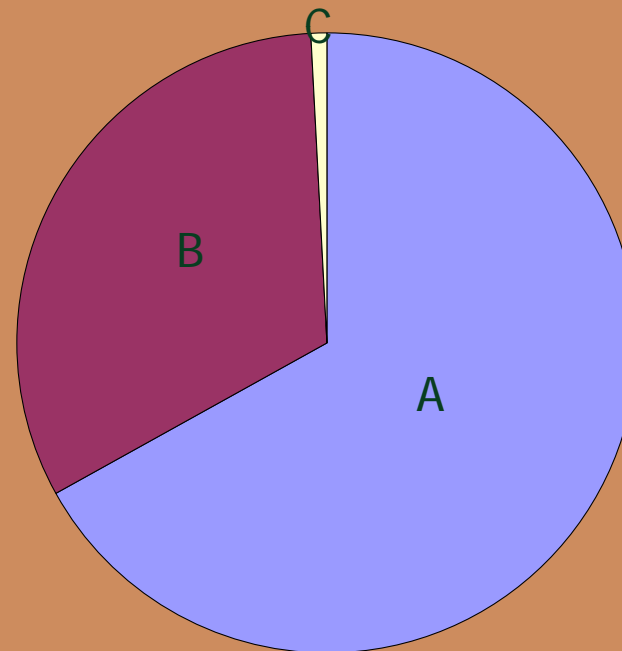


Molecular Biology Results

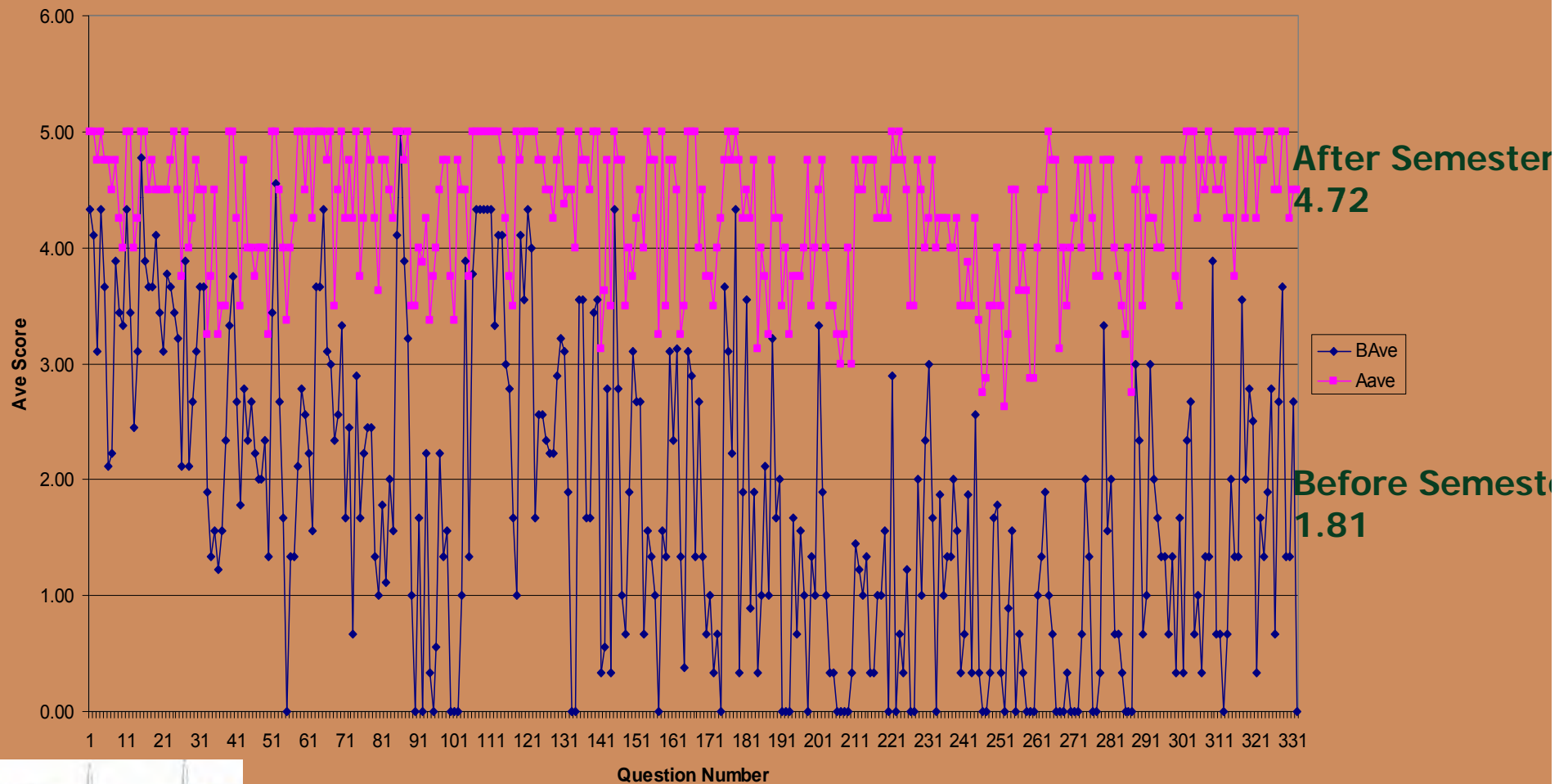
Before Semester
1.81



After Semester
4.72



Molecular Biology Results



Molecular Biology Results

	Bave	Aave	Delta
GENERAL KNOWLEDGE AVERAGE	3.01	4.39	1.38
Chapter 1 Average	2.33	4.48	2.15
Chapter 2 Average	2.52	4.50	1.98
Chapter 3 Average	2.21	4.47	2.27
Chapter 4 Average	1.07	4.13	3.05
Chapter 5 Average	2.96	4.71	1.75
Chapter 6 Average	1.78	4.28	2.49
Chapter 7 Average	1.11	3.92	2.81
Chapter 8 Average	1.95	4.33	2.38
Chapter 9 Average	0.72	3.75	3.03
Chapter 15 Average	0.84	4.49	3.64
Chapter 10 Average	1.49	4.21	2.72
Chapter 11 Average	0.67	3.53	2.86
Chapter 12 Average	0.53	4.24	3.71
Chapter 13 Average	0.87	4.05	3.18
Chapter 14 Average	1.81	4.28	2.46
Chapter 16 Average	1.22	4.51	3.29
Chapter 17 Average	1.91	4.72	2.81
ALL QUESTIONS AVERAGE	1.81	4.31	2.50



Genetics 2009 Results

Before the semester

General Knowledge

17 students, 49 questions,
315 A's, 362 B's, 153 C's; 3 N/R
Average score 3.21

Genetics Lab

17 students, 32 questions
194 A's, 161 B's, 188 C's
Average score 2.68

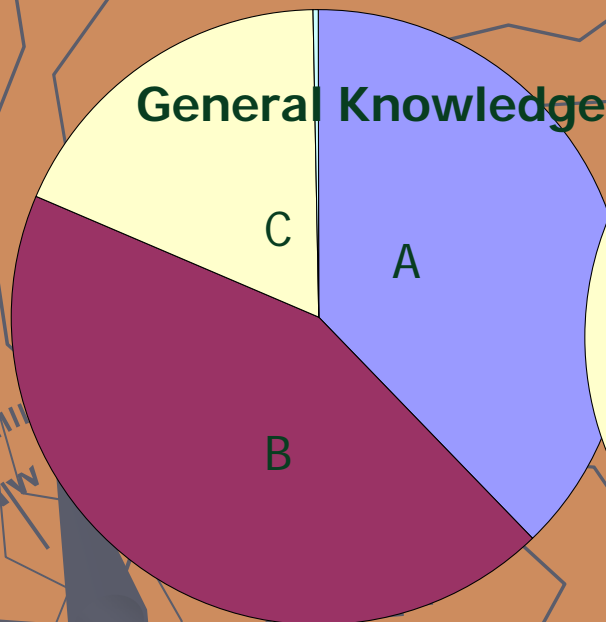
Genetics Biology

17 students 514 questions,
1124 A's, 2508 B's, 5072 C's; 30 N/R
Average score 1.46

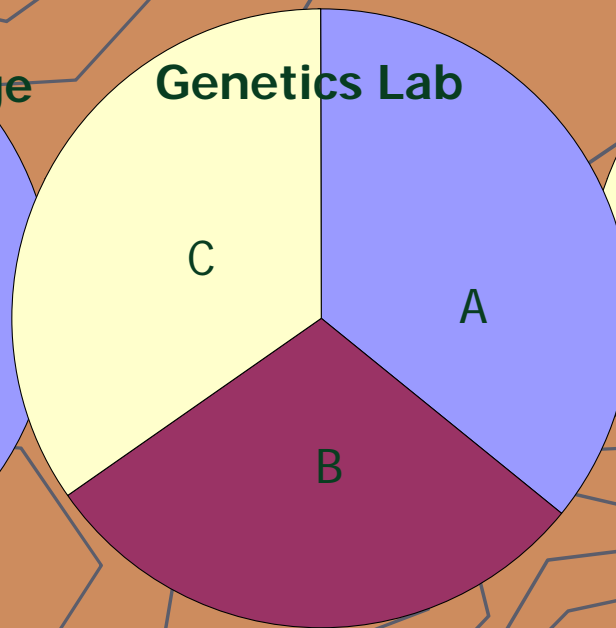


Get Into It!

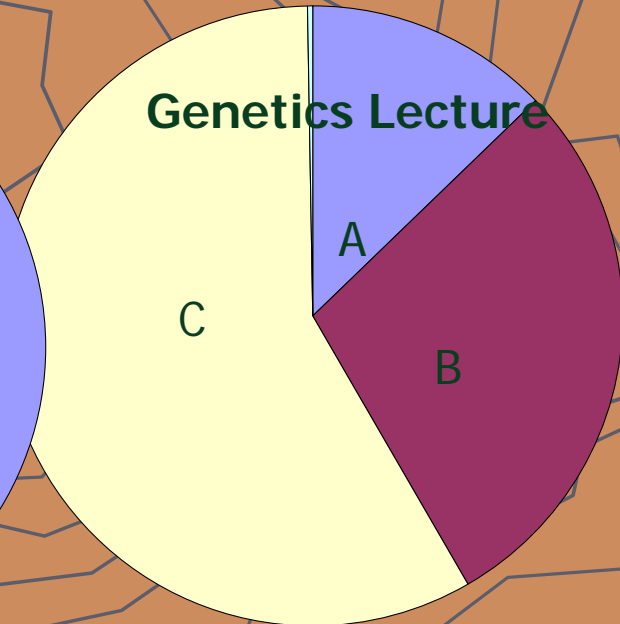
Spring 2009 Results Before the semester



17 students, 49 questions,
315 A's, 362 B's, 153 C's; 317 students, 32
N/R
Average score 3.21



17 students, 32
questions
194 A's, 161 B's, 188 C's
Average score 2.68



17 students 514 questions,
1124 A's, 2508 B's, 5072 C's; 3
N/R Average score 1.46

Spring 2009 Results After the semester

Before Semester

General Knowledge

17 students, 49 questions,
315 A's, 362 B's, 153 C's; 3 N/R
Average score 3.21

Genetics Lab

17 students, 32 questions
194 A's, 161 B's, 188 C's
Average score 2.68

Genetics Lecture

17 students 514 questions,
1124 A's, 2508 B's, 5072 C's; 30 N/R
Average score 1.46

After Semester

General Knowledge

14 students, 49 questions,
412 A's, 226 B's, 46 C's, 2 NR
Average score 4.00

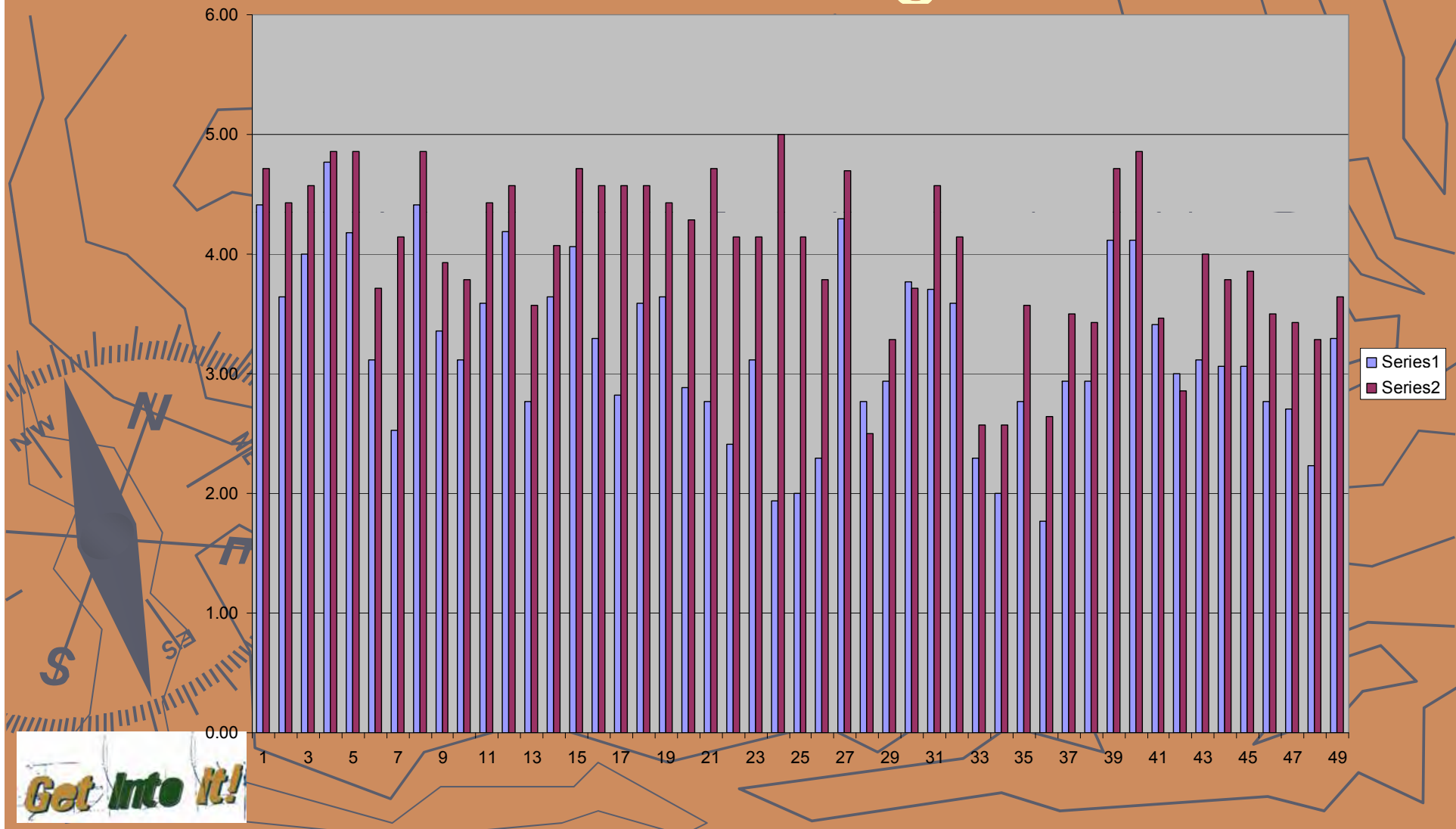
Genetics Lab

10 students, 32 questions
348 A's, 93 B's, 6 C's, 1 NR
Average score 4.52

Genetics Lecture

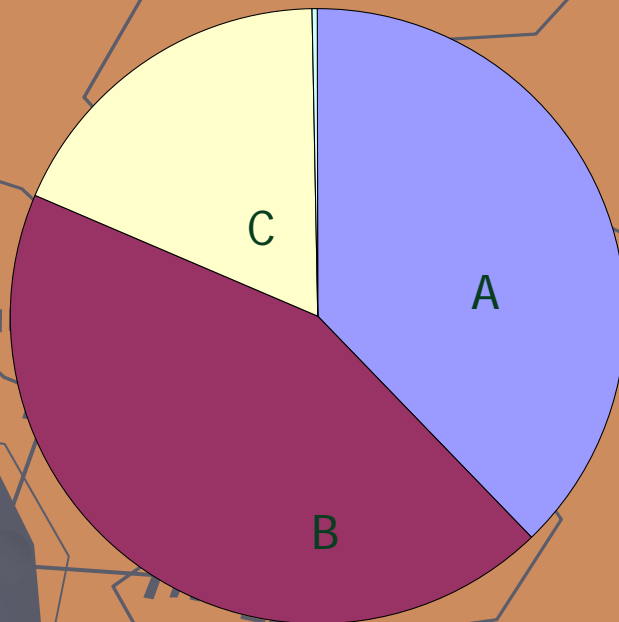
14 students 514 questions,
4445 A's, 2159 B's, 587 C's; 11 NR
Average score 4.18

2009 Core Knowledge Results

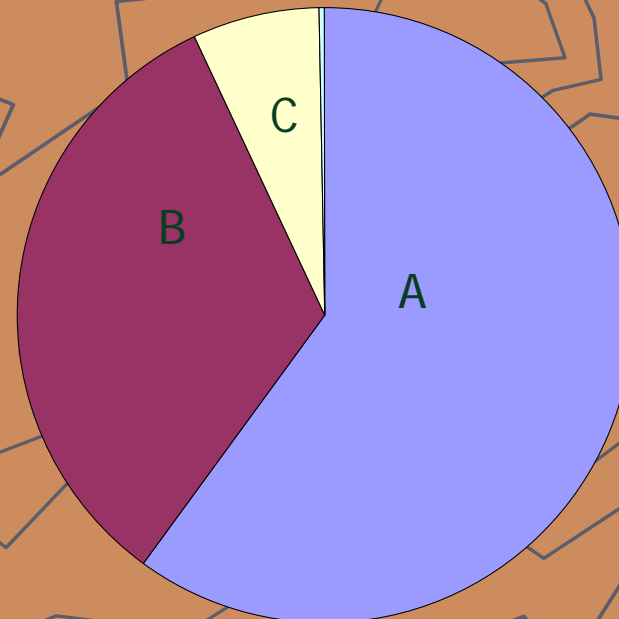


2009 Core Knowledge Results

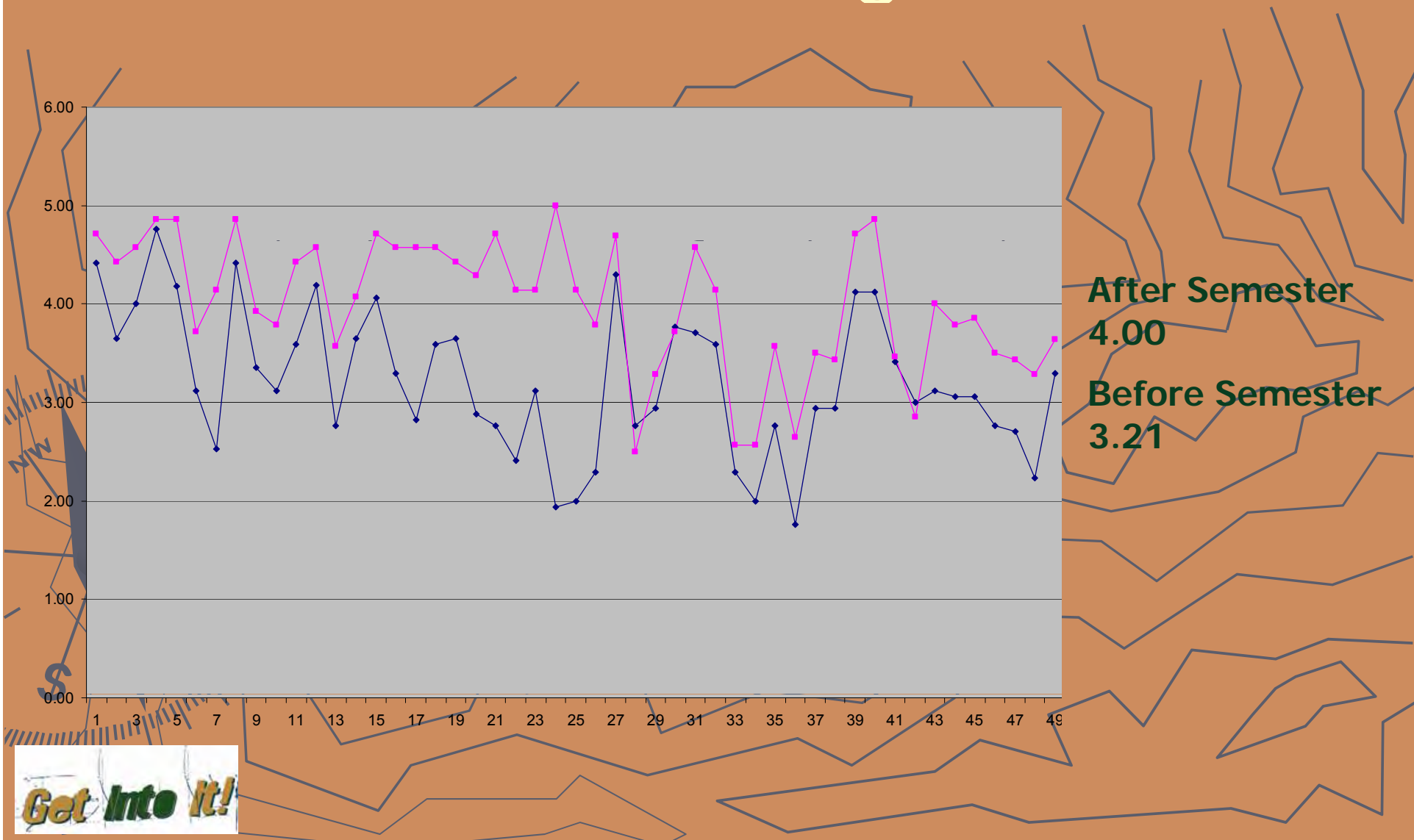
Before Semester
3.21



After Semester
4.00

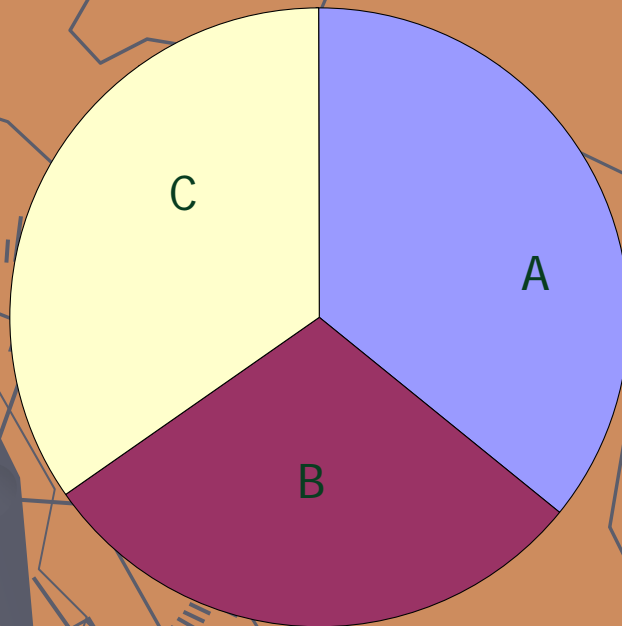


2009 Core Knowledge Results

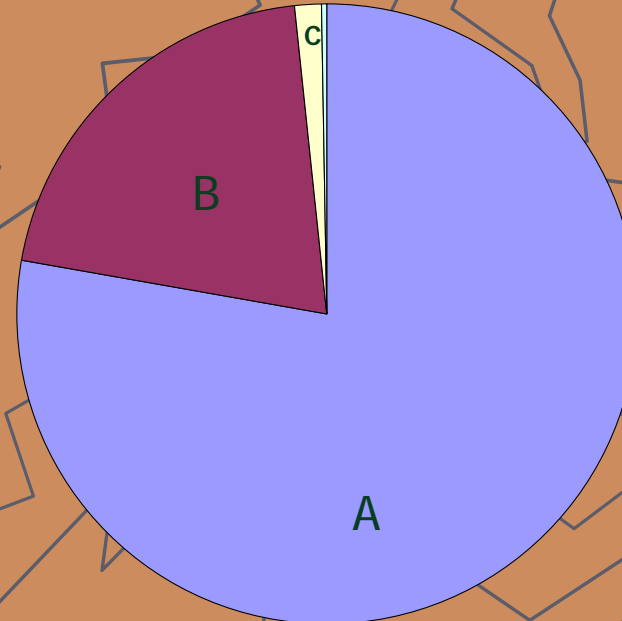


Genetics Lab Results

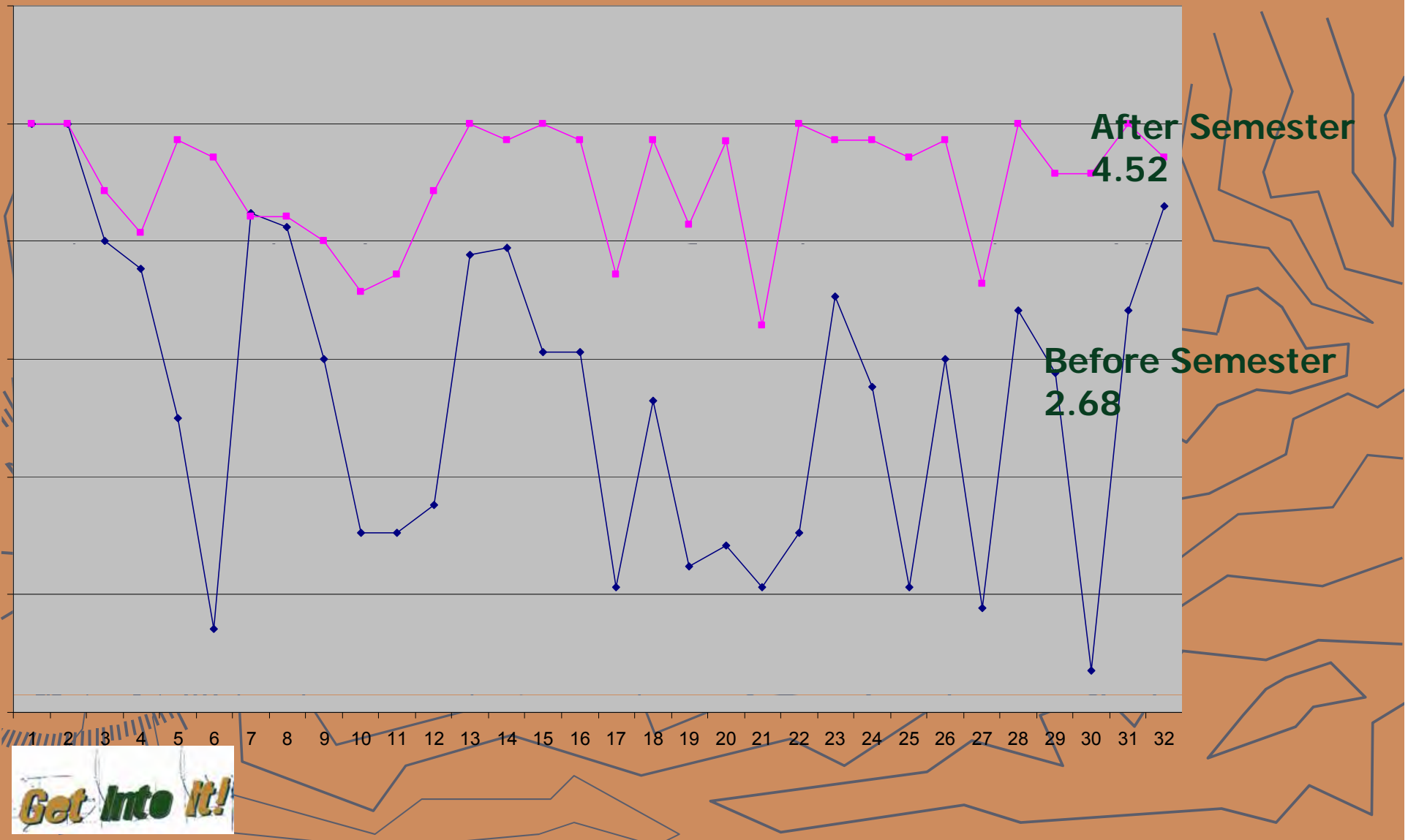
Before Semester
2.68



After Semester
4.52

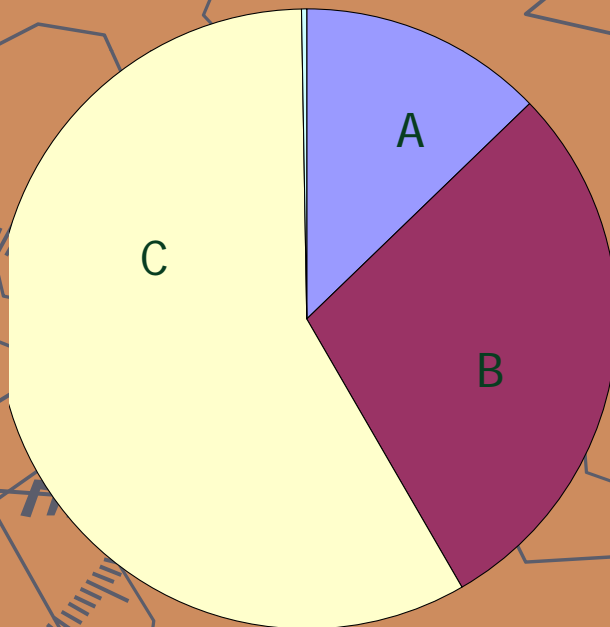


Genetics Lab Results

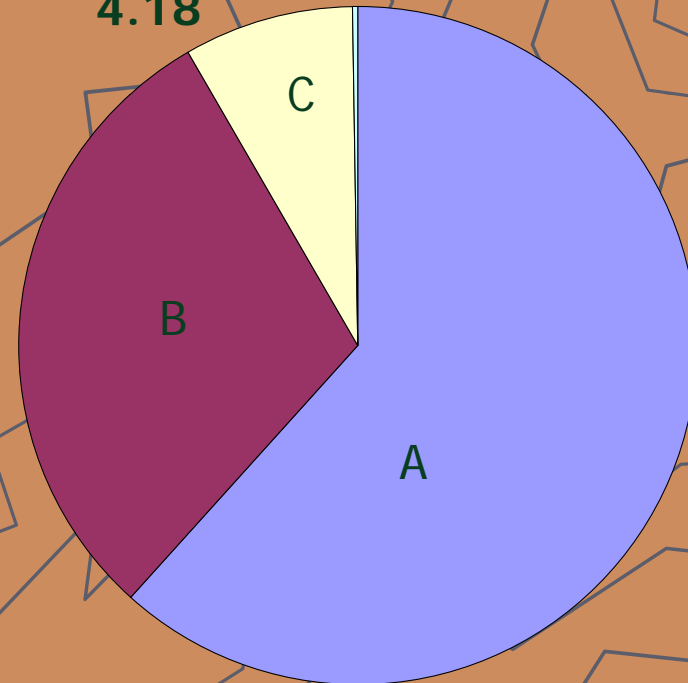


Genetics Results

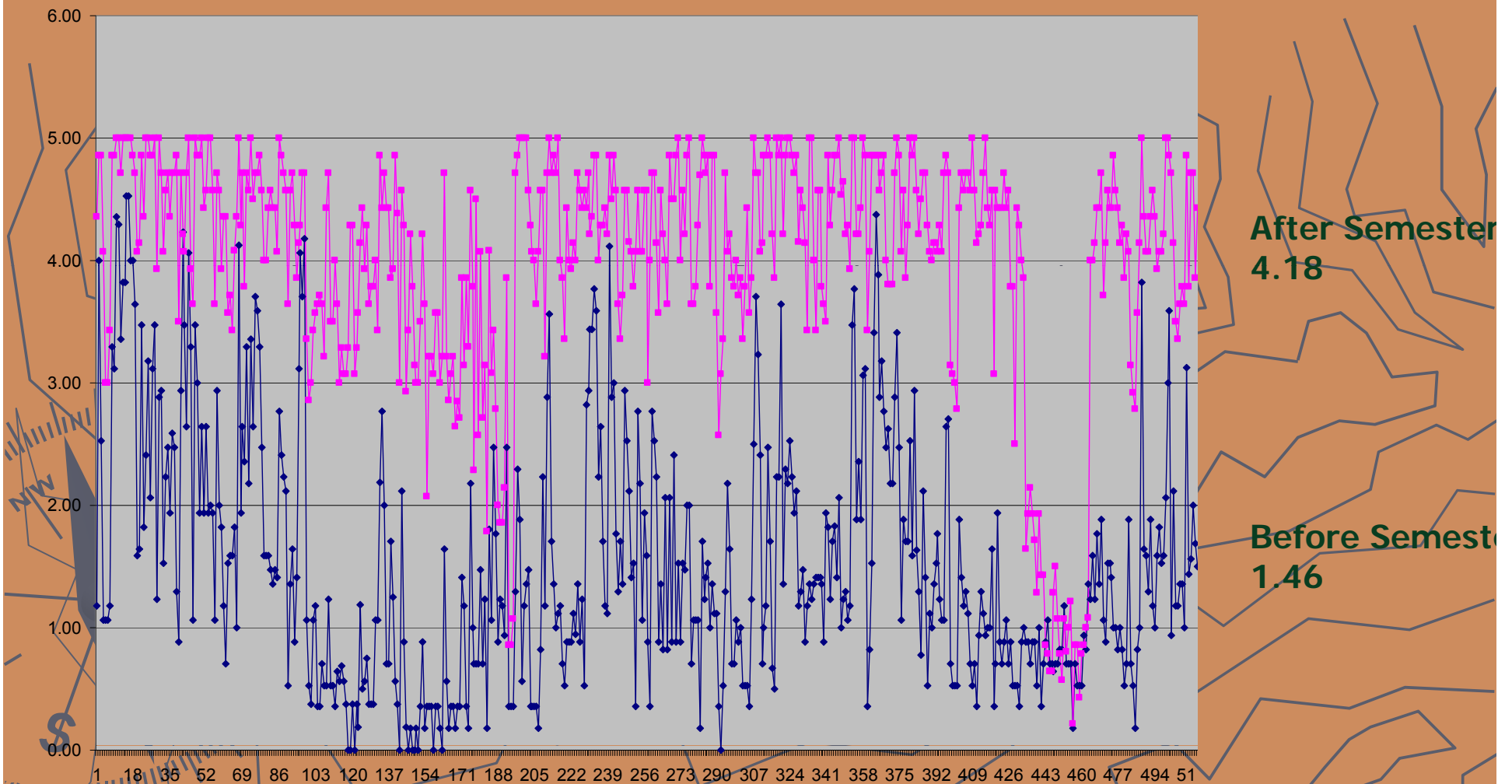
Before Semester
1.46



After Semester
4.18



Genetics Results



After Semester
4.18

Before Semester
1.46

Genetics Results

	Before Avera ge	After Avera ge	DELTA
General Knowledge	3.21	4.00	0.80
Chapter 1 Average	2.73	4.52	1.79
Chapter 2 Average	1.94	4.40	2.46
Chapter 3 Average	2.17	4.44	2.28
Chapter 4 Average	1.39	3.95	2.56
Chapter 5 Average	0.40	3.73	3.33
Chapter 6 Average	0.85	3.94	3.08
Chapter 7 Average	0.45	3.29	2.84
Chapter 8 Average	1.13	2.73	1.60
Chapter 9 Average	1.22	4.43	3.21
Chapter 10 Average	1.95	4.28	2.33
Chapter 11 Average	1.21	4.25	3.04
Chapter 12 Average	1.40	4.27	2.87
Chapter 13 Average	1.76	4.48	2.72
Chapter 14 Average	1.94	4.31	2.37
Chapter 19 Average	0.94	4.36	3.42
Chapter 20 Average	0.77	1.30	0.53
Chapter 24 Average	1.46	4.18	2.72
All Questions Average	1.66	3.99	2.33



Get Into It!

Areas for Improvement

Automate it!!!!

References

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Karl Wirth and Dexter Perkins
Knowledge Surveys: An Indispensable Course Design and Assessment Tool. Innovations in the Scholarship of Teaching and Learning. Available at <http://www.macalester.edu/geology/wirth/WirthPerkinsKS.pdf>. Accessed 12/15/08



Acknowledgements



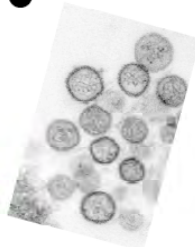
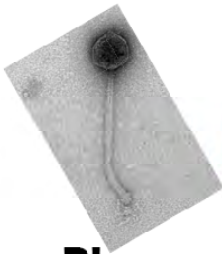
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"Got virus?"

Biological Sciences

at

MontanaTech
THE UNIVERSITY OF MONTANA



Phage and Hantavirus Hunting Programs



MT Tech Instructional Improvement
Committee



Questions?

Discussion